Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

4281.9
Ag 8

SHIPMENT OF CORN EARWORM PUPAE THROUGH THE U.S. POSTAL SYSTEM

Production Research Report No. 138

U. S. DEPT. OF AGRICULTURE
NATIONAL AGRICULTURAL LIBRARY
RECEIVED
JAN 12 1972
PROCUREMENT SECTION
CURRENT SERIAL RECORDS

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE
in cooperation with
University of Georgia
Agricultural Experiment Station

345676

SHIPMENT OF CORN EARWORM PUPAE THROUGH THE U.S. POSTAL SYSTEM

By J. Wendell Snow, R. L. Jones, A. N. Sparks, R. L. Burton, and W. W. Cantelo,
entomologists, Entomology Research Division
Agricultural Research Service

Since 1967, the Southern Grain Insects Research Laboratory, Tifton, Ga., has made shipments of thousands of the corn earworm (*Heliothis zea* (Boddie)) over distances of several thousand miles for use in special projects. These projects were designed to test the feasibility of suppressing or eradicating the corn earworm population from the island of St. Croix, U.S. Virgin Islands, via the sterile male technique.[1] Shipment of insects from the location of the rearing facility to the point of release is one of the major problems in a mass release program. The problem appears small when only hundreds of insects are shipped per day, but it becomes monumental when thousands of insects are shipped per day.

Results of studies with thermotubes packed with pupae in vermiculite and shipped to St. Croix indicated excessive heat was the factor most damaging to pupae. This heat was thought to be the result of heat accumulated during shipment of parcels via truck from Tifton, Ga., to Atlanta, Ga. However, when the pupae and vermiculite were cooled, packed in a styrofoam box, rather than cardboard, and shipped to St. Croix, it was discovered that metabolic heat from the pupae produced 100-percent mortality. Such unknown problems can be devastating and have led to investigation of various shipping methods by trial and error as well as controlled scientific experimentation. To aid researchers faced with similar shipping problems, the results of experiments on shipping methods are summarized.

INSECT STAGES AND METHODS

Experimentation showed that earworm moths could be held in storage for 2 days at 50° F. with no apparent damaging effects. However, a container to maintain these temperatures and provide protection during transit was not available. Shipment of certain stages of larvae in diet-filled 1-ounce plastic cups proved practical from an injury standpoint, but proved highly impractical because of the economics of the excessive shipping weights and facilities for rearing the larvae when they reached their destination. Although the pupal stage of the corn earworm is very fragile and extremely susceptible to injury, it is the most advantageous stage for shipment in the postal system.

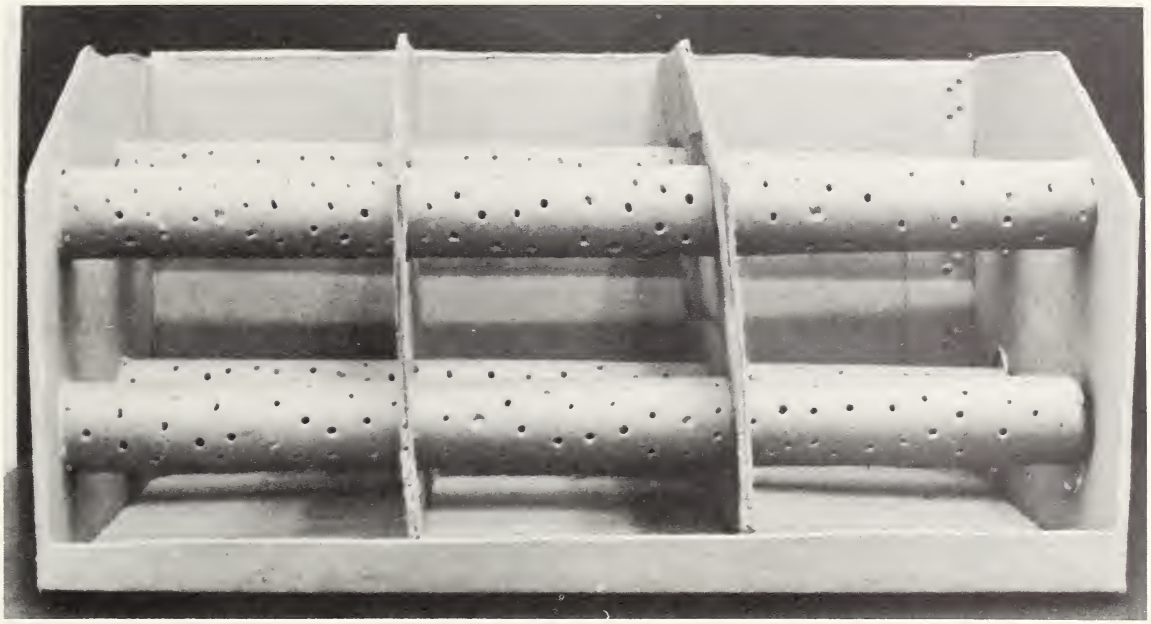
The corn earworms were reared by the procedure described by Burton.[2] Pupae were collected 20 days after eggs were isolated into the diet-filled 1-ounce plastic cups. After simulated or actual shipment procedures were completed, pupal mortality records were calculated and numbers of sound adults per test or shipment were recorded. The words "sound adults" are used to indicate moths that appeared physically sound (undeformed).

ACTUAL SHIPMENTS DURING PROJECTS

Pupal shipping containers of assorted sizes and shapes constructed of various materials were used during the projects to ship pupae from Tifton to St. Croix. A cutaway view of the container showing the most promise is illustrated in figure 1. The dimensions of the cardboard box are 2.5 by 1 by 1.2 feet. Perforated center tubes allowed exchange of air and dissipation of heat and the partitions added strength to the container and kept the pupae separated. Approximately 2,000 pupae per container were thoroughly mixed with woodshavings or dry vermiculite for shipment. The procedure consistently resulted in 15 to 40 percent greater loss than in nonshipped pupae—depending upon

[1] Snow, J. W., Burton, R. L., Sparks, A. N., and Cantelo, W. S. Attempted Eradication of the Corn Earworm From St. Croix, U.S. Virgin Islands. U.S. Dept. Agr. Prod. Res. Rpt. No. 125, 12 pp. 1971.

[2] Burton, R. L. Mass Rearing the Corn Earworm in the Laboratory. U.S. Dept. Agr., Agr. Res. Serv. ARS 33-134, 8 pp. 1969.



PN-2358

Figure 1.—Container used to ship pupae from Tifton, Ga., to St. Croix.

age of pupae shipped, time in transit, and the care the box received during shipment. However, this procedure was the most practical method available during the projects. The addition of more pupae per container resulted in excessive loss due to the accumulation of metabolic heat. Moisture added to the container before shipment resulted in loss of rigidity of the shipping container with subsequent losses of pupae; however, moistening the vermiculite at destination improved moth emergence.

SIMULATED PUPAL SHIPMENTS

A series of shipment procedures were screened under simulated shipping conditions. Pupae were packaged in the boxes (1 by 1 by 1 feet) with various test materials for 2 days and stored at 100° F. Each day the boxes were removed from the high temperature, placed on a shaker cycling 12 inches per second for 1 hour, and then dropped 10 times from a height of 6.5 feet onto a vinyl-covered concrete floor. In total, the pupae were subjected to 46 hours of 100°, 2 hours on the shaker, and 20 drops from 6.5 feet. Each treatment was replicated six times with 150 to 300 pupae per replicate. Table 1 shows the percentage of sound adults with eight of the treatments. For analysis, data were converted by the arcsin transformation.

Table 1.—Survival of pupae under simulated shipping conditions when packaged in various materials

Packing material	Percentage sound adults[1] [2]
Loose in vermiculite	1.2
Loose in woodshaving	1.6
Loose in shredded paper	7.2 a
Loose in Pelespan ®	0
Rolled in cotton	9.6 a
Loose in styrofoam chips	6.2 a
Styrofoam with chambers	0
Foam rubber with chambers	18.7 b
Control	66.7 c

[1] Analysis not applied to packing materials with less than 2 percent sound adults.

[2] Means followed by the same letter are not significantly different at the 5-percent level.

The severity of the simulated shipping procedure prevented good survival with any treatment. However, when individual depressions were cut in foam rubber (0.25 inch deep), significantly higher survival rates were obtained. These results encouraged us to investigate the foam rubber procedure in greater detail.

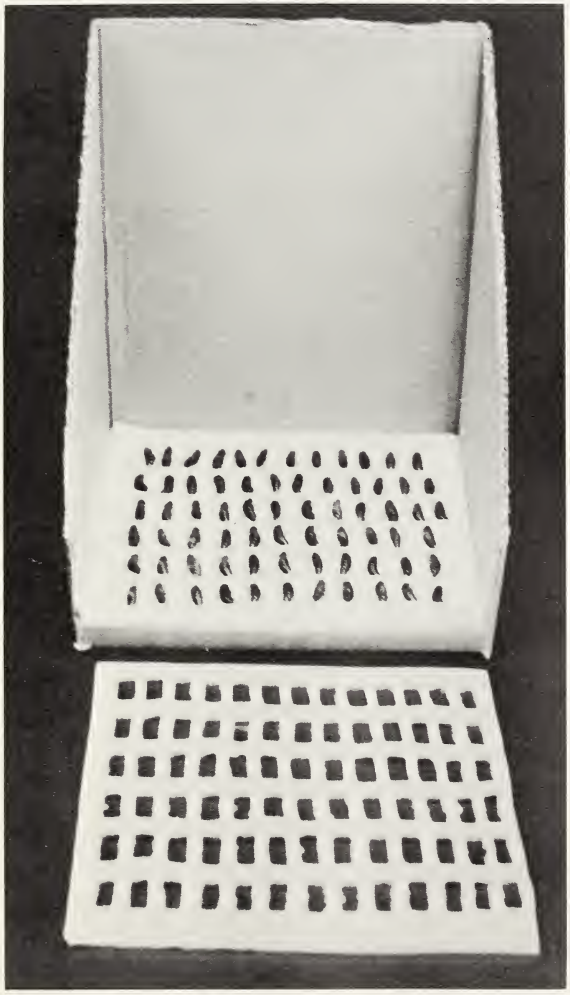
U. S. DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH SERVICE
BELTSVILLE, MARYLAND 20705

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF
AGRICULTURE

SENSITIVITY TO DROPS

Testing had shown that pupae were more sensitive to dropping than to the heat or shaking procedure. Thus, foam rubber packing was compared with the woodshaving packing. Figure 2 illustrates pupae packed in foam rubber before placement in the shipping box. A compartment was prepared by cutting 11.75- by 11.75-inch sections from 0.25-inch foam rubber and burning 0.25- by 1.0-inch holes with the modified head of a hot soldering iron. The compartmented piece of foam rubber and the pupae were then sandwiched between two additional sheets of foam rubber. Up to 1,000 pupae were placed in each box. There were apparently no problems with accumulation of metabolic heat.



PN-2359

Figure 2.—Illustration of foam rubber packing technique.

Laboratory comparisons of the two packing procedures were evaluated for their ability to prevent pupal mortality. In these tests 100 pupae per box were dropped 10 times from various heights, and other boxes of pupae were dropped from 5.25 feet for various numbers of times. The number-of-drops experiment was replicated four times and the height-of-drop experiment, three times. Table 2 shows the data obtained in both experiments.

Table 2.—Average survival of 100 pupae packaged in woodshaving or foam rubber and dropped in indicated times and heights

Treatment	Sound adults with —		
	Wood-shaving	Foam rubber	Control
Number of drops from 5.25 feet:			
0	---	---	91
5	26	77	---
8	21	78	---
13	6	71	---
20	1	72	---
Height of drops (10 drops each):			
0	---	---	92
1.5	78	88	---
2.3	57	89	---
3.5	34	83	---
5.25	9	78	---

When pupae were dropped various numbers of times in the woodshaving treatment, a logarithmic relation existed between the number of times dropped and sound adults. This did not occur in the foam rubber treatments. The regression was calculated as: $y = 65.6 - 51.2 X$ $r = 0.990$, where $X = \log$, or number of drops, and $y =$ percentage survival. Significantly more sound adults were obtained with the foam rubber packing method than from the woodshaving packing. In addition, no significant differences were detected between the control and any of the foam rubber number-of-drop treatments.

When pupae were dropped 10 times from various heights, again, the woodshaving relation was logarithmic. The regression was expressed by the equation:

$y = 101.7 - 127 X$ r = 0.999, where X = log of height of drop, and y = percentage survival. Significantly more adults were obtained with the foam rubber than with the woodshaving treatment, but the differences between the foam rubber and the control were nonsignificant.

Thus, these experiments indicate that the woodshaving method was sensitive to handling, with damage related directly to the severity of handling, and that the foam rubber packing offered maximum protection.

SHIPMENTS TO ST. CROIX

The foam rubber and standard woodshaving methods were compared in five actual shipments of pupae from Tifton to St. Croix. A range of 200 to 500 pupae were mailed per shipment with the same number held in Tifton as controls. The actual trip to St. Croix usually required 2 days with three changes of aircraft along the way. All shipments were in pressurized cargo compartments (commercial carriers). Data from these series of tests are shown in table 3. The foam rubber treatment resulted in more sound adult moths than the woodshaving treatment. The means for the foam rubber treatment and the control were identical. However, the reader should consider that different personnel made evaluations of the soundness of moths at the two locations.

Table 3.—Percentage sound adults resulting from pupae packaged in partitioned foam rubber or in woodshaving and shipped to St. Croix

[Percentages converted to Arcsin for analysis]

Replicate No.	Percentage sound adults with —		
	Woodshaving	Foam rubber	Control[1]
1	66	77	83
2	66	87	78
3	([2])	91	81
4	49	81	88
5	62	85	91
Mean[3]	60.8 b	84.2 a	84.2 a

[1] Control remained in Tifton.

[2] No observation.

[3] Means followed by the same letter are not significantly different at the 5-percent level.

SUMMARY AND CONCLUSIONS

The use of partitioned foam rubber for protection of pupae in transit eliminated the substantial mortality normally sustained in their shipment. Initially, it appears that the foam rubber procedure of packing is expensive. However, there is a possibility of automating the procedure. If this is achieved, the costs could be reduced. Moreover, when the costs of mass producing a cannibalistic lepidopterous insect are considered, such expenditures could be justified on the basis that mortality could be essentially eliminated by protective shipping measures and thus, save 10 to 40 percent of the insects normally lost.

Trade names are used in this publication solely to provide specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

Washington, D. C. GPO: 1971 O—451-704 Issued November 1971

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 10 cents
Stock Number 0100-1591